**Task 8: Science Inquiry**

Constructing an Energy Efficient Vehicle from a Mouse Trap

Maisum Syed

**The Mousetrap Car Analysis Report**

Answer the following questions completely (include formulas and/or calculations where appropriate). Your answers may be written below or typed and submitted on SEQTA. It must be a minimum of three hundred words.

1. **What are the two types of friction that affect the performance of your vehicle?**

The two types of friction that affect our vehicle is air resistance and surface friction. Air hits the vehicle and slows it down. The more aerodynamic the vehicle is the better air coefficient it will have, thus being more efficient and going a further distance. This is exactly why electric cars have no front grills, and are shaped exceptionally smooth and slippery, to increase their range. The wheels also have friction with the ground surface. They can be smooth, thin, and lightweight to increase efficiency. We taxed on the idea of being lightweight and being as aerodynamic as possible. Our wheels were also built with most efficiency in mind. Air resistance and gravity force are the two distance forces. These forces affect how the automobile moves.

1. **What problems related to friction did you encounter and how did you solve them?**

We encountered the wheel friction and how having bottle caps as wheels would increase friction and would reduce the performance. This is because the plastic caps have ridges in them that cause the friction to increase. We used CDs which were very thin and more aerodynamic, which reduced air resistance. We also put the mousetrap and the string at the rear of the vehicle, so when the lever pulls, the weight on the back wheels is more, which increases friction. We do not care much about front wheels since those are not propelling the vehicle. We were worried that because we used lighter materials, our vehicle would be too little air resistant, and that the smoothness of the CD wheels would create too much friction with the surfaces that it would have to roll over.

1. **What factors did you consider deciding the number of wheels you chose in your design?**

The ultimate reduction ratio will also rise as the wheel diameter increases, which has the dual effect of decreasing acceleration potential while increasing peak speed. In other words, a car will accelerate more slowly and reach greater peak speeds if its tires are larger. If we used one wheel at the front, we would have to make the axle more complex since the wheel would need to be in the center to balance. We chose four wheels because the vehicle would be more stable and make front axle simpler. The four wheels outweigh the cons.

1. **What kind of wheels did you use in each axle? What is the effect of using large or small wheels?**

We used CDs for both wheels. We used CDs for both wheels because they are lightweight, aerodynamic, and would be best for long distance. Large rear wheels enable the automobile to go a greater distance with just one axle movement. In other words, a given length of the mousetrap's string causes the automobile to drive farther. The last piece of advice is to put up your mousetrap as close as you can to the front of the vehicle. Any extra weight will cause your automobile to move more slowly or with more friction. It is also important to keep in mind that broad wheels may even slightly increase a car's drag because of air resistance. For these reasons, you should get the lightest, thinnest wheels you can for your vehicle.

1. **Explain how Newton's first, second and third laws apply to the performance of your vehicle.**

According to Newton's first rule, a moving object tends to keep moving until it is acted upon by an outside force, whereas a stationary object tends to stay that way until it is acted upon. The mousetrap automobile is an example of Newton's first law in action since it is propelled by the force of the mousetrap before moving and continues to drive until it collides with an object or is eventually stopped by gravity. Our mousetrap car will be affected by Newton's second rule of motion because the heavier the car is, the slower it moves. However, a lighter automobile will drive more quickly since it requires less force to move due to its lower mass. The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object). Newtons second law of motion will affect our mousetrap car because the more the car weighs the slower it goes. There is an equal and opposite response to every action, according to Newton's third law. Because there is an equal and opposite response to every action, Newton's third law has an impact on the automobile. This indicates that when the automobile rolls, friction pushes against it less forcefully, allowing the car to continue to travel. But as the automobile continues to move, the forces balance out, causing it to slow down until it ultimately comes to a halt.

1. **Discuss the effect of the length of the lever arm in the pulling force of your vehicle.**

Increasing the length of the mouse trap's lever arm will increase the quantity of string that can be pulled from the driving axle while decreasing the pulling force. If we used a longer level the vehicle would go a longer distance in total but be slower when it accelerates. Using a shorter level result in the vehicle travelling less distance but making it move much faster. This is because the shorter level takes less time to pull the string and move the rear wheels. Because the length of the level is shorter, there is more torque, causing wheels to spin faster, and in less time. All together results in faster vehicle.

1. **Discuss the types of energy transformations that occur in your car.**

There is potential energy stored in the lever/string. When the level is pulled, it is converted into kinetic energy. The energy stored in a mousetrap spring is found using the formula: EPE = ½⋅k⋅θ2, where k is spring constant of the mousetrap spring, a measure of how “tough” the spring is and θ is the angle (in radians) the torsional mousetrap spring compresses. The mousetrap vehicle worked as a spring when it was wrapped, increasing the elastic potential energy. As a result, when the force compressing the mousetrap is released, the mousetrap returns to its original position. Two energy changes happen as one releases the mousetrap. First, when the automobile accelerates, potential energy changes into kinetic energy because kinetic energy rises with velocity. The automobile will eventually come to a complete halt because friction is converting the kinetic and potential energy into heat at the same time. All the potential and kinetic energy in the automobile has been turned into heat when it comes to a full halt.

1. **List the energy types that are wasted in your car.**

Heat and sound are the energy types that were wasted in our car. The Law of Conservation of Energy, which asserts that while energy cannot be generated or destroyed but can shift from one form to another, the overall quantity of energy in a system will always remain constant, governs all other laws. The potential energy that is stored when a mouse trap's spring is loaded is converted into kinetic energy when the spring is released, but the overall quantity of energy that the system starts with and ends with is always the same. Once potential energy is converted to kinetic energy, a mousetrap vehicle would roll in an ideal world indefinitely. Heat is wasted when the wheels rotate and friction is there, there is only a tiny amount of heat, but it is still heat, converted from the energy in the string. There is also sound that is made when the vehicle moves.

1. **Discuss how you increased the efficiency of your vehicle (reduced the wasted output energy).**

We lowered the weight of the vehicle. The distance and speed our mousetrap vehicle can go depend on how much weight it has. This result results from the mousetrap's limited energy. The energy required to resist the gravitational energy of the vehicle rises as it gets heavier, leaving less energy available to move the automobile ahead and lowering its speed and range. This entails lowering the friction on our car's surfaces where points bump into one another. To ensure that an automobile "runs" as smoothly as possible, we maintained the points of contact between its moving components well-oiled by using a light lubricant like WD-40, auto grease, or a comparable substance.